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"WHITE ANTS"[1] AS PESTS IN THE UNITED STATES AND METHODS OF PREVENTING THEIR DAMAGE.

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INTRODUCTION.

The serious damage which "white ants," or termites, cause to a great variety of wood products, as well as to growing plants, can be prevented. This publication gives a brief account of these insects, their habits and damage, and shows how losses from this source may be avoided. The most serious damage by white ants is that caused to foundation timbers and the woodwork of buildings and to the material stored therein. Similar damage to other construction timber in contact with the ground is considerable, especially in the Southern States.

[1] The species principally treated herein are *Leucotermes flavipes* Kollar, *L. virginicus* Banks, and *L. lucifugus* Rossi.

Injury to living trees and shrubs, growing crops, or other vegetation is only occasional and local and usually occurs because the land has been cleared recently and there is much decaying wood and humus in the soil. There are several kinds of termites, or white ants, in the United States, but those which are best known and most commonly reported as injurious belong to three small, closely related, and very similar species [1] of more or less general distribution.

DESCRIPTION AND HABITS OF WHITE ANTS.

"White ants" are not true ants, although they are superficially antlike and live in colonies made up of different forms or castes and

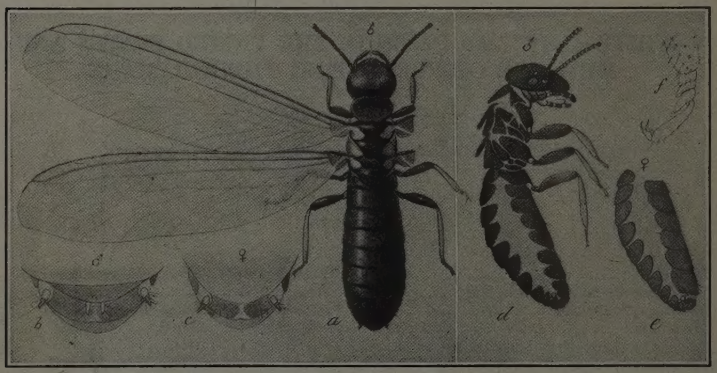

FIG. 1.—Winged forms of the white ant known as *Leucotermes flavipes: a*, Adult male; *b*, terminal abdominal segments from below; *c*, same of female; *d*, male, side view, somewhat inflated by treatment with ammonia; *e*, abdomen of female, side view; *f*, tarsus, showing joints and claws. *a*, *d*, *e*, Enlarged; *b*, *c*, *f*, greatly enlarged. (Marlatt.)

are social insects. In these nests or colonies both wingless and winged mature individuals are produced. The brownish, or blackish, elongate, slender, antlike, sexed adults (fig. 1) with long white wings, unlike the other forms, have functional eyes and are able to endure full sunlight. These migratory males and females appear normally only once a year during a short period. The grayish-white, soft-bodied, wingless "workers" (fig. 2) are in reality the destructive form. These workers make the excavations and enlarge and extend the colony as this becomes necessary. They live underground and shun the light and are therefore rarely seen. The soft-bodied, wingless "soldiers" (fig. 3), which have an elongate, narrow head armed with long, slender, saber-shaped jaws, and the workers are the most

[1] *Leucotermes flavipes* Kollar, *L. virginicus* Banks, and *L. lucifugus* Rossi; order Platyptera, suborder Isoptera, family Mesotermitidæ.

numerous forms permanently present in the colony. Other forms in the colony are the reproductive individuals; in some colonies these consist of a single pair, the normal king (fig. 4) and queen (fig. 5), while in other colonies many supplementary nymphal (fig. 6) or larval types may be present. These reproductive forms never reach the size attained by those of certain species of termites in the Tropics and never lose the power of movement.

White ants are essentially wood destroyers and live in nests in the wood of dead trees, decaying logs, or stumps in the forest; in the

FIG. 2.—Mature "workers" of the white ant known as *Leucotermes flavipes;* etherized specimens. Enlarged nearly six times. (Original.)

foundation timbers of buildings, fences, or other structures of wood in contact with the ground; or in a labyrinth of underground passages in the earth, usually underneath wood or other vegetation. An average colony contains several thousand individuals. Owing to their subterranean habits and often countless numbers, it is sometimes very difficult to destroy them when once they are established in a building. Always coming up through underground galleries, they work in the interior of the wood and leave intact a protective outer shell, so that the damage is often unsuspected until beyond repair.

LIFE CYCLE OF WHITE ANTS.

There are three stages in the life of white ants; namely, the egg, the immature form (larvæ, or nymphs), and the mature individual (including workers, soldiers, and the various reproductive forms).

Egg laying occurs over a considerable period of time during the warm months in colonies out of doors, but in infested buildings where an even temperature is maintained, especially those occupied by man,

FIG. 3.—Mature "soldiers" of the white ant known as *Leucotermes flavipes;* etherized specimens. Enlarged nearly six times. (Original.)

the insects are active and egg laying may occur during every month of the year. The number of eggs laid by each reproductive form depends on its age.

THE SWARM.

At a certain season of the year the winged, sexed individuals migrate in large numbers from the parent nests to found new colonies. The season during which swarming takes place varies with the species

and the geographical locality, usually occurring in the spring or fall. There are often several swarms from the same nest, sometimes as many as four separate swarms, extending over a period of one month. In infested buildings the winged males and females usually swarm a month or more earlier than outdoors, and the more common species [1] was observed to swarm as early as the middle of February in infested buildings in Washington, D. C. Numerous urgent requests are received by the Department of Agriculture for information in regard to these "flying ants" in buildings.

FIG. 4.—Mature "king" of normal form of the white ant known as *Leucotermes flavipes;* several years of age. Etherized specimen, enlarged six times. (Author's illustration.)

FIG. 5.—True "queen" of the white ant *Leucotermes flavipes,* with wing stubs and chestnut-colored hard parts. Etherized specimen, enlarged six times. (Author's illustration.)

DAMAGE TO WOODWORK OF BUILDINGS AND TO OTHER TIMBER.

Damage to foundation timbers, flooring in basements, and other woodwork of buildings,[2] both in rural regions and in large cities, is common and often serious in the southern portions of the United States, especially in the South Atlantic and Gulf States. Injury of this type, however, has been recorded as far north as Manchester, N. H., and the shores of the Great Lakes (Benton Harbor, Mich.).

White ants live in wood which is in contact with, or can be reached from, the ground. The workers are able to travel comparatively long distances through subterranean galleries in search of wood and

[1] *Leucotermes flavipes* Kollar.

[2] Such injury in the Gulf States, Southwestern States, and California is caused also by *Calotermes* spp. (fig. 7) and in Florida by *Cryptotermes cavifrons* Banks.

in extending their colonies, and usually gain entrance to buildings from colonies outdoors. Infestation of the interior woodwork is effected from underground tunnels to and up through moist or decayed foundation timbers, flooring, or supports of porching or steps set in or on the ground.

Beams, such as joists, studding, stringers, and other foundation timbers in the basement or cellar, even though entirely inclosed or embedded in concrete, are but partially protected from attack by termites. In the settling of the structure, or in weathering, concrete is

FIG. 6.—Supplementary nymphal reproductive forms of the European white ant *Leucotermes lucifugus;* one king and three queens. Colorado Springs, Colo. Enlarged 10 times. (Original.)

almost sure to crack and allow moisture and insects to enter. Furthermore, beams and joists put down in moist concrete decay rapidly and become exceptionally good breeding places for these insects; from such beams white ants carry their burrows up through the timbers to the first, second, and even third floors.

Flooring (fig. 8) and other stationary woodwork and furniture frequently become infested when the wooden beams are laid directly on the earth or in moist concrete; they are often reduced to mere shells, the interior being completely honeycombed. Termites usually follow the grain when working in solid wood.

Termites are able to extend their burrows throughout dry, hard wood and other dry substances far removed from the ground, and over impenetrable material, provided there is access to moisture

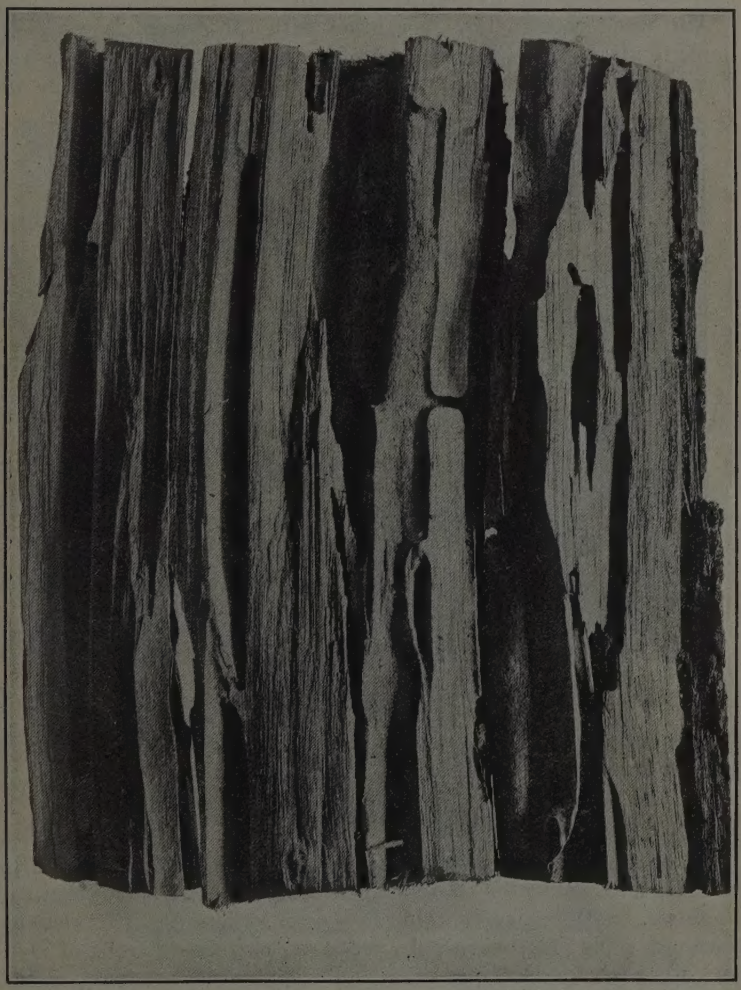

FIG. 7.—Work of a western white ant, *Calotermes* sp., in Mexican walnut. Catalina Mountains, Ariz. (Original.)

elsewhere, i. e., damp earth. They make use of a mixture of moist earth and finely digested, excreted wood in creating more favorable conditions of moisture and shelter while extending their galleries. White ants prefer to work in dark, warm, moist places.

Termites even pass over substances they can not penetrate, such as metal or stone, brick, or concrete foundations, by means of small shelter sheds or granular, earthlike tubes constructed of earth and excrement extended up from the ground.

Any wood construction in contact with the ground is especially liable to attack by white ants. Among these may be listed construction timber in bridges, wharves, and similar structures, telephone and

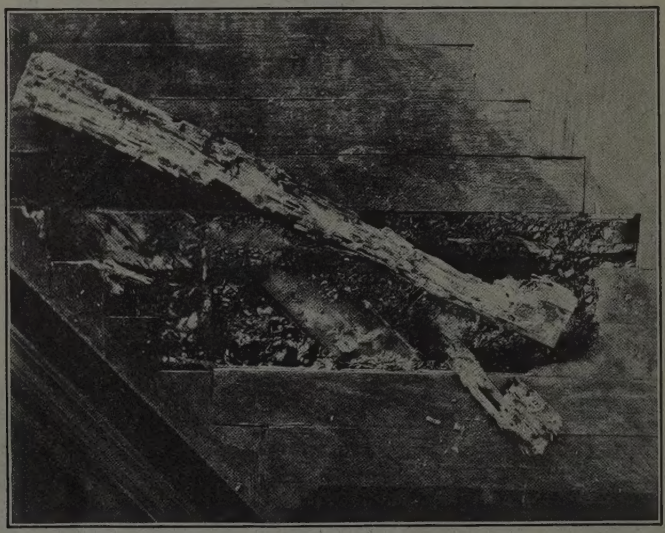

FIG. 8.—Oak floor honeycombed by white ant *Leucotermes flavipes*. Washington, D. C., July, 1915. Photograph by C. H. Popenoe. (Author's illustration.)

telegraph poles,[1] mine props, railroad ties, posts, lumber piled on the ground, wooden boxing for cables, cypress water tanks, etc.

DAMAGE TO STORED MATERIAL.

Of the stored material sometimes seriously injured or destroyed by termites may be mentioned wooden electrotype blocks and other wood products, books or papers in libraries or elsewhere (fig. 10), valuable documents (fig. 11), wood-pulp products, pasteboard, rolls of cloth and other fabrics, clothing, shoes and other leather products, as well as food stored on shelves or on the floors in dark, damp basements or cellars, or similar moist places where the ventilation is poor.

[1] In California damage to poles by *Termopsis angusticollis* Walker (fig. 9), and in the Gulf States by *Calotermes* spp. also occurs.

DAMAGE TO FRUIT, NUT, SHADE, AND FOREST TREES.

Termites occasionally injure living trees and shrubs. In Florida they have caused considerable damage to newly planted groves of orange trees, having eaten away the bark about the collar and root and completely girdled the trees. Similar damage by white ants has been recorded to other fruit trees, as apple, peach, pear, cherry, plum,

FIG. 9.—Work of a large western white ant, *Termopsis angusticollis*, in western yellow pine. Placerville, Cal. (Original.)

apricot, and lemon, especially in the Southern States and in California; and also to pecan, chestnut, and walnut trees. Such damage is more common in the new soil of recently cleared woodland containing old decaying stumps or much humus.

In cities and elsewhere, a great variety of shade trees are injured by white ants, the insects infesting the roots and the heartwood

at the base of injured trees. Sometimes the infested trees are plastered with earthlike tubes or galleries.

Particularly in the South, termites render insect, fire, and disease killed timber unmerchantable, unless the timber is utilized within a reasonable period after being killed. They also damage the roots and lower trunks of injured living trees.

DAMAGE TO FIELD CROPS AND GRAZING LAND.

In the Southern States white ants occasionally injure the stems and roots of a great variety of apparently healthy field crops, including both grain and truck crops, among which may be listed corn,

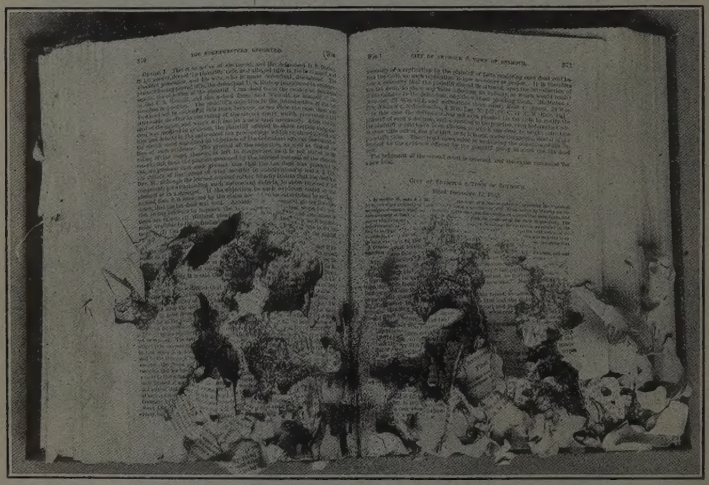

FIG. 10.—Book from library at Van Buren, Ark., ruined by white ants. June, 1915. (Author's illustration.)

cotton, sugar cane, rice, grasses, potatoes, and a great variety of garden vegetables.

Injury to corn in the prairie region of Kansas has resulted from the earlier presence of the insects in enormous numbers in the heavily sodded soil where they feed on the roots of the vegetation. Sometimes this injury to growing corn is due also to the method of plowing under old stubble.

In the prairie regions of Texas and Arizona a tube-forming termite[1] lives in the ground, feeding on the roots of grass and other vegetation, and is often found under and within dry cow dung and under stones. This species sometimes destroys the vegetation over large areas of grazing land. One of its characteristic habits is to cover

[1] *Hamitermes tubiformans* Buckley.

the stems and roots of vegetation with tubes of small diameter constructed of earth and excrement.

DAMAGE TO NURSERY STOCK, YOUNG PLANTATION STOCK, AND VINEYARDS.

There are numerous records of termite injury to young fruit and nut-tree seedlings in nurseries, to other nursery stock, and to

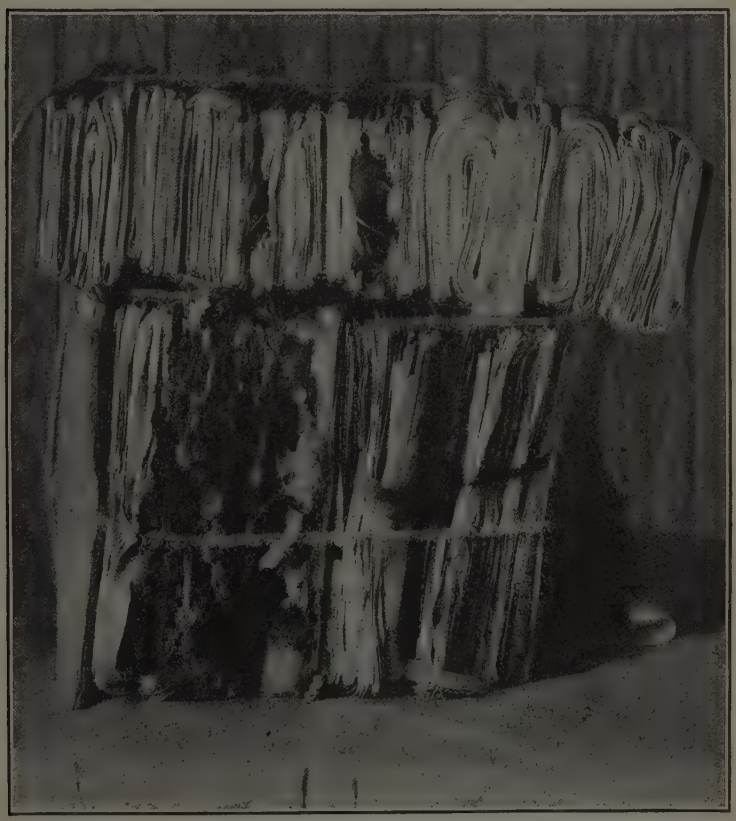

FIG. 11.—Damage by the white ant *Leucotermes flavipes* to bundles of old documents stored on tiers of wooden shelves standing on pine flooring in heated, damp, dark basement of an old building in Washington, D. C. Note how an earthlike mixture of moist earth and finely digested, excreted wood is carried into the mines of the insects in the bundles. If the connections of the termites with the ground or decayed wood, their source of moisture, be shut off, the insects perish. (Original.)

young trees planted in recently cleared ground or soil rich in humus. The injury, however, has been only occasional and not extensive. The stock is usually attacked at a scar, where the roots have been injured or cut off, or at a graft, as cleft-graft apple stock.

Injury by termites to vineyards has occasionally been recorded in North America. Usually only the old vines are attacked, or dead or injured parts. Signs of attack are sickly foliage or abortive buds, or the injury is observed at the time of cutting down to stock or grafting.

DAMAGE TO SHRUBS, FLOWERS, AND GREENHOUSE STOCK.

White ants injure a variety of shrubs, weeds, and flowers in gardens as well as in greenhouses. Heavily manured flower beds are a source of infestation to the stems of flowers as well as to the woodwork of houses. In greenhouses old label sticks, the wooden uprights supporting wooden benches set on or in the ground, and the wooden bench bottoms and plant pots are often attacked by white ants, and this leads to subsequent attack of the growing plants.

In the Greenhouse Insect Investigations of the Bureau of Entomology, carried on at Washington, D. C., records have been made of serious injury to many plants grown under glass, and control methods have been tried by Arthur D. Borden, who has found that heliotropes, begonias, bedding geraniums, carnations, chrysanthemums, and roses are seriously injured by white ants. One hundred and eighty out of 1,000 heliotrope plants were killed the first week after being potted from the seeding pans. As many as 75 white ants have been found in a 4-inch pot of heliotrope. The insects come up through the ground and form dirt galleries over the supports, or burrow up through the wooden bench legs and run galleries the full length of the wooden benches. They enter the soil through the drainage holes of the pots and eat out the main stalk of the root, killing the plant very quickly.

PROTECTION OF WOODWORK IN BUILDINGS.

PREVENTION OF THE DAMAGE.

Since white ants are difficult to eliminate from the woodwork of a building when once established, every precaution should be taken to prevent their gaining an entrance

In order to prevent the insects from reaching the woodwork of buildings from their nests in the ground, the foundations should, where possible, be entirely of stone, brick, or concrete, including the pillars in the basement or cellar. The walls, partitions, and flooring in the ground floor, basement, or cellar should also be of concrete. Wooden flooring can be laid over this concrete floor if more desirable. An air space should be left between the concrete floor and the wooden floor laid over it. Concrete floors should be laid on a gravel base which will prevent dampness and cracking. The points of juncture between concrete walls and flooring should be filled in by rounding off the concrete at these places, since cracks often occur where the wall and

floor join at right angles; termites often come up through cracks between walls and flooring.

The publications of the Department of Agriculture should be consulted in regard to the specifications for the proper proportioning, mixing, and placing of concrete.[1] Recent tests conducted by the Office of Public Roads and Rural Engineering have demonstrated the value of mixing a heavy mineral residual oil with Portland cement paste to form an admixture [2] almost perfectly nonabsorbent of water and therefore an excellent material to use in damp-proof construction, as flooring, etc. Where the various patent or noiseless floorings are used on the ground floor, they should always be laid over a concrete base, especially if they contain wood fiber as a constituent.

Bungalows or frame buildings in the country which have no cellar should be raised from the ground on stone foundations to a height which will allow light and air to penetrate beneath.

Where stone or concrete foundations are impracticable, timber impregnated with coal-tar creosote should be used. Untreated beams should never be laid on the earth nor imbedded in moist concrete, since they will rot, even if they do not become infested.

Beams in no case should be completely surrounded with mortar or brick; there should be an air space around the beams so as to permit air circulation. Beams should not be set *in* earth or *in* moist concrete but should be set *on* rock or dry concrete.

The supports of the woodwork of coal bins in basements or cellars should not be set in the ground but should rest on concrete. Window sills and frames in the basement or cellar should be laid over concrete, and the woodwork should not come in contact with the ground. There should be no untreated wood in contact with the ground through which white ants can come up from subterranean galleries. Complete dryness of foundation timbers and basement walls and flooring is an important means of rendering buildings safe from attack by white ants. Good subventilation should be secured; that is, a deep air space should be left between the ground and wooden flooring. If the flooring is to be of concrete, the concrete should be laid on a gravel base to prevent dampness. The supports of porches or steps should never be laid directly on the ground but should rest on rock or concrete.

In case of the plank platforms in front of suburban railroad stations, even if the planking be laid on the proper foundations the boards should not be joined closely together, but at least a $\frac{1}{4}$-inch space should be left between to allow light and air to penetrate and to prevent dampness and infestation by white ants. Often these

[1] The use of concrete on the farm. U. S. Dept. Agr. Farmers' Bul. 461, 23 p., 10 fig. 1915.
Concrete construction on the live-stock farm. U. S. Dept. Agr. Farmers' Bul. 481, 32 p., 24 fig. 1915.
[2] Page, L. W. Oil-mixed Portland cement concrete. U. S. Dept. Agr. Bul. 230, 26 p., 6 pl., 5 fig. 1916.

platforms are roofed over and the wooden pillars supporting the roof are sometimes raised slightly off from the planking on iron rests. This prevents dampness, decay, and attack by white ants at the base (fig. 12). In other cases these pillars are set on a concrete base to one side of the planking, where they are not affected if the wooden boards of the platform decay.

In the construction of greenhouses, iron frames and concrete work should be used in place of woodwork wherever possible, as this woodwork is often seriously injured by termites owing to the warm moist atmosphere maintained throughout the year. The wooden uprights supporting the wooden plant benches should never be set on or in the ground but should rest on stone, bricks, or concrete above the

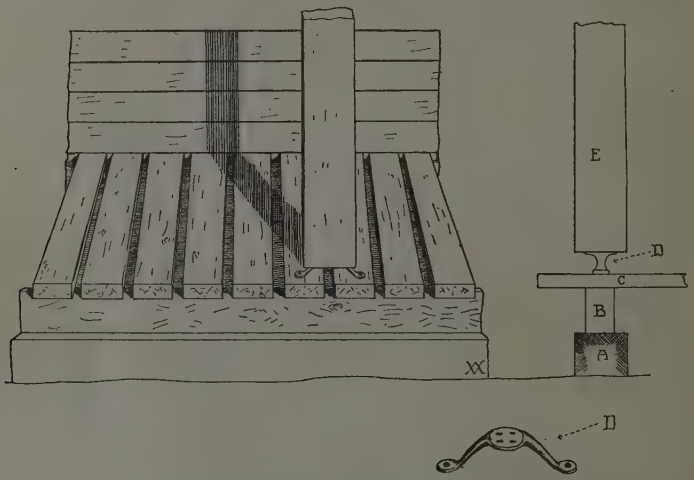

FIG. 12.—Properly laid platform planking and foundations for pillars, Falls Church, Va.: *A*, concrete base; *B*, stringer; *C*, planking; *D*, iron rest; *E*, pillar. (Original.)

surface of the ground. Where woodwork is necessary, wood impregnated with a 1 per cent solution of bichlorid of mercury should be employed.

All decaying wood in the vicinity of buildings should be removed and the breeding places of the insects destroyed.

Buildings on recently cleared woodland, unless the foregoing precautions are heeded, are especially liable to attack by white ants because of the presence of decaying wood and humus in the soil.

REMEDIAL MEASURES.

LOCATION OF DAMAGE.

As has been stated, it may be difficult to eliminate and stop further damage by white ants when once these insects have become established in the woodwork of a building. The approximate point of

entrance should be sought at once by careful examination of all woodwork in contact with the ground. The foundation timbers, such as beams and joists in contact with the ground, and other woodwork in the basement or cellar should be examined so that the point of entrance of the insects and the extent of the damage already accomplished may be determined. It may be necessary to tear up the flooring and other woodwork to do this. The foundation timbers and interior woodwork found damaged should be removed, and the ground where they were set drenched with kerosene oil.

The annual emergence of large numbers of the flying white ants is an indication that the woodwork is infested, and the point of emergence indicates the approximate location of the infested timbers. Even if the insects are not observed swarming, large numbers of the dead winged adults or the discarded wings usually will be found near by. Frass and earth thrown out of crevices through which the insects emerge are also evidences of their presence. Sometimes the insects plaster the surface of wood with earthwork which will disclose their presence.

When efforts are made to stop further damage by termites in buildings, it should be realized that their numbers may be constantly recruited from some undiscovered, outside, central colony. The destruction of the winged colonizing adults at the time of emergence, while beneficial in preventing the establishment of potential new colonies, will not eradicate the insects infesting the woodwork.

Another warning of the presence of termite infestation is branching shelter tubes of small diameter, constructed of earth mixed with finely comminuted wood, on foundation timbers or other woodwork (fig. 13), or over the surface of stone, brick, or other impenetrable foundation material (fig. 14) from the ground to the woodwork. Drenching the ground where these tubes originate with kerosene oil will afford relief.

SUBSTITUTION OF STONE FOUNDATIONS AND TREATED TIMBER.

It is very rarely possible to find and destroy the external colony. The main purpose therefore must be to prevent the insects from gaining further access to the woodwork from colonies in the ground. This may be accomplished by replacing untreated foundation timbers and other woodwork in the basement or cellar with stone or concrete, including stone columns or pillars to support the flooring above, concrete or tile flooring, and concrete walls and partitions in the basement or cellar. If it is not practicable to substitute stone foundations, foundation timbers in contact with the ground should be replaced with timbers impregnated with coal-tar creosote.

Since the insects may have entered the building from their subterranean galleries by means of the supports of porchings and steps set

in or on the ground, these last should be removed and the ground soaked with kerosene oil.

In some cases thorough and repeated drenching of infested timbers, where accessible, with kerosene oil may afford temporary relief and kill many of the white ants. Kerosene oil should be poured into the crevices through which the winged insects emerge and on the ground where the earthlike shelter tubes originate. Very rarely, however, is any permanent relief effected by these means alone.

In greenhouses iron frames and concrete work should, wherever possible, replace woodwork. The wooden uprights supporting the

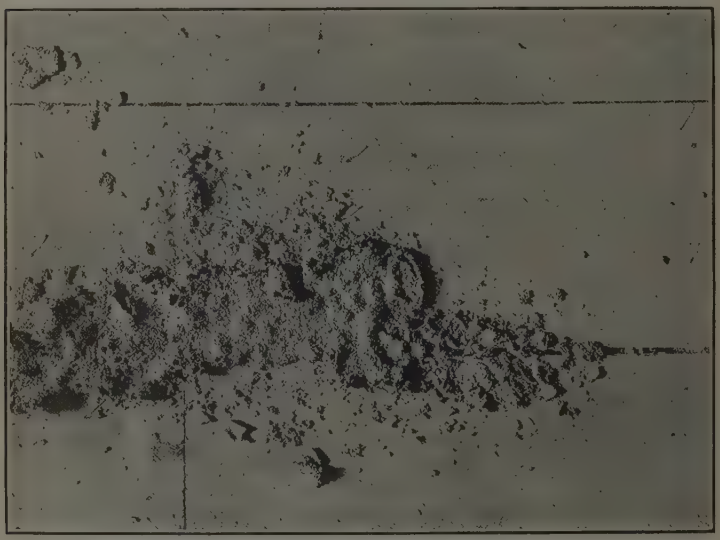

FIG. 13. Earthlike shelter of the white ant *Leucotermes flaripes*, built on pine flooring in heated, damp, dark basement. The worker termites have come up through cracks between boards of the infested floor and made craterlike openings for the emergence of the winged, sexed adults. Note the shed wings on the floor. The swarm occurred February 14, 1916, in an old building in Washington, D. C. (Original.)

wooden plant benches should be sawed off, if set on or in the ground, and rested on stone, bricks, or concrete above the surface of the ground. Where woodwork is necessary, wood that is impregnated with a 1 per cent solution of bichlorid of mercury should be substituted. Wood impregnated with this preservative can be painted after treatment.

Poles, posts, construction timber, and other wood in contact with the ground should be treated with chemical preservatives to render the wood more resistant to attack by termites. Of the more superficial methods of preserving timber, brush or dipping treatments

with coal-tar creosotes and carbolineums have proved to be the most effective. The most permanent known practical method is to impregnate the wood under pressure with coal-tar creosotes Where it is impracticable to treat such timbers, as poles, posts, etc., to be set in contact with the ground, they should be selected from woods noted for durability and resistance to attack by white ants.

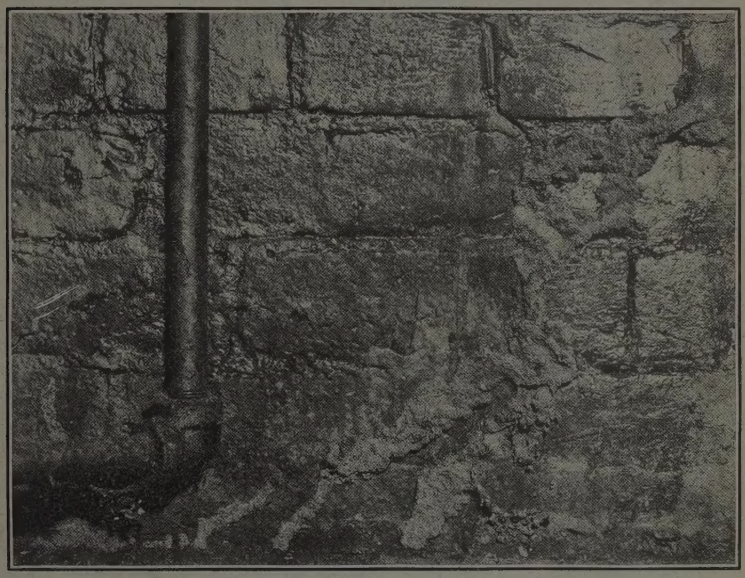

FIG. 14.—Earthlike shelter tubes of the white ant *Leucotermes flavipes*, constructed of earth mixed with finely digested, excreted wood, and built over brick wall in heated, dark, damp basement. These tubes extend through cracks between the basement pine flooring and the wall near a steam radiator. Note the granular structure. The insects use these tubes in passing over impenetrable substances and to protect them from the light in extending their galleries—in this case up to the next floor in an old building in Washington, D. C. (Original.)

PROTECTION OF STORED MATERIAL.

Injury to books, paper, documents, and other stored material or products is usually indirect, the insects as a rule burrowing through such material only where it is in contact with infested wood. Hence, if the insects are kept out of wooden structures, by the means already described, such damage can be prevented. Books, valuable documents, etc., should not be packed away in warm, unventilated chambers where they may become moist and moldy, and, therefore, particularly subject to attack by white ants. It should be borne in mind that termites are likely to be present in old buildings, even though their work has not been sufficient to attract attention. Once contact with the source of moisture (damp earth) is shut off, the

insects infesting stored material soon leave, die out, or can be killed by spreading out infested books, documents, and other stored material or products to dry in the sun or in an oven, or outdoors during cold weather. Temperatures over 160° F. will kill the insects.

PROTECTION OF LIVING TREES.

Owing to the subterranean habits of white ants, it is extremely difficult to prevent or remedy injury to living forest, fruit, or shade trees. Care should be taken that the trees do not become scarred near the base, in order to prevent heartrot and subsequent infestation. Clean forest, orchard, and horticultural management is to be recommended. Properly executed tree surgery [1] sometimes may be effective in repairing damage to valuable old trees. Dead and dying infested trees should be removed and burned. Prunings should be burned promptly.

PROTECTION OF NURSERY STOCK, VINEYARDS, AND FIELD CROPS.

Injury to nursery stock will be most serious on recently cleared land where there is abundant decaying wood. Such débris, in which the insects breed, should be removed. In general, the use of recently cleared land should be avoided in planting nursery stock. Care should be taken not to allow the roots to dry out before planting; such weakened stock is liable to attack. In the case of the pecan, it is recommended that two or three cereal crops be grown on newly cleared land before the young trees are set out. The use of commercial fertilizers instead of stable manure is suggested. Deep late-fall plowing should be of value in breaking up subterranean nests. The practice of better farming methods, with rotation of crops, will prevent damage to field crops.

In vineyards, care should be taken in pruning operations; all dead or diseased vines should be removed. All pruned areas should be painted with coal tar, and the prunings should be burned promptly.

PROTECTION OF FLOWERS AND GREENHOUSE STOCK.

In flower or truck gardens, especially those located near the woodwork of buildings, less stable manure should be used in order to protect, not only the building, but also the growing plants.

The very volatile liquid carbon bisulphid can be used to kill white ants in the soil if moist and not compact, if small holes be made near the infested plants and a small quantity of carbon bisulphid poured in and the hole immediately closed tightly with earth. Care should

[1] Collins, J. F. Practical tree surgery. *In* U. S. Dept. Agr. Yearbook for 1913, p. 163-190, pl. 16-22, 1914.

be taken in handling this inflammable and explosive fluid, and the fumes should not be inhaled.

In the experiments conducted by Borden, in the Department of Agriculture at Washington, an effective control was found in the use of a 5 per cent kerosene-emulsion solution.[1] In case the benches can not be replaced immediately on account of a certain crop, it has been found practical to soak the ashes or sand under the pots and the infested benches thoroughly with this solution. This may be done by removing the potted plants from a section of the bench, spraying that section, and moving the pots on the bench up to cover the treated area, thus exposing another section to be treated. Potted heliotrope and geranium have been treated directly with the 5 per cent kerosene-emulsion solution without injury to the plants and the white ants in the soil of the pots were all killed. This treatment should be given late in the afternoon and followed early next morning with a thorough syringing with water to wash the surplus oil out of the soil. It is important also to remove all infested pots promptly from the bench as soon as they are noticed and to destroy the white ants with kerosene emulsion.

The removal of decayed infested woodwork in greenhouses will prevent the plants from becoming infested in turn.

SUMMARIZED RECOMMENDATIONS FOR PROTECTION OF WOODWORK IN BUILDINGS.

HOW BUILDINGS SHOULD BE CONSTRUCTED SO AS TO BE "WHITE-ANT PROOF."

Where possible, make the foundation of buildings entirely of stone, brick, or concrete, including stone columns or pillars in the basement to support the floor above; make the walls and flooring in the basement or cellar also of concrete, and lay concrete floors on a gravel base. Fill in and round off points of juncture between concrete walls and flooring so that these will not meet at right angles.

Where stone or concrete foundations are impracticable, use timber impregnated with coal-tar creosote.

Never completely surround beams with mortar or brick; leave an air space around the beams to permit air circulation. Set beams *on* stone or *on* concrete, not *in* the earth or *in* moist concrete. Rest the supports of porches or steps on stone or concrete.

Lay basement window sills and frames over concrete and do not allow the woodwork to come in contact with the ground. Never sink

[1] Kerosene emulsion formula:

Kerosene, 2 gallons.
Fish-oil soap, ½ pound.
Water, 1 gallon.

Method of preparation: Dissolve soap in hot water and pour in oil slowly while constantly stirring so as to emulsify.

Dilution: If 37 gallons of water be added to the above stock solution, it will give 40 gallons of 5 per cent kerosene emulsion.

untreated timber in the ground or in moist concrete; let there be no wood in contact with the ground through which the termites may come up from subterranean galleries.

Complete dryness of the foundation and basement walls and flooring is an important means of rendering buildings safe from attack; therefore, provide for air spaces between the ground and wooden flooring and lay concrete floors on a gravel base.

In greenhouses, replace woodwork, wherever possible, with iron frames and concrete work. Treat necessary woodwork, before use, with a 1 per cent solution of bichlorid of mercury.

HOW TO ELIMINATE WHITE ANTS ALREADY ESTABLISHED IN BUILDINGS.

Promptly examine the foundation timbers and other woodwork in the basement to determine the approximate point of entrance and the extent of damage already accomplished. After removing the damaged wood, drench the ground with kerosene oil.

Break up the earthlike shelter tubes by means of which white ants are sometimes able to pass over the surface of impenetrable substances in order to reach woodwork, and drench the ground beneath with kerosene oil.

Then replace damaged timber with rock, brick, or concrete; or, if this be impracticable, substitute, for the foundation, timbers treated with coal-tar creosote.

Since termites always require access to damp earth, shut off this source of moisture, and the insects will not be able to extend the galleries farther and will perish.

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